

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application.

Listing of Claims:

1. (Original) A self-lubricating expansion mandrel for expanding a tubular member, comprising:
 - a housing that defines a lubrication supply chamber including a tapered outer surface;
 - a supply of a lubricant material within the lubrication supply chamber;
 - one or more grooves formed in the tapered outer surface;
 - solid lubricant retained in one or more of the grooves; and
 - means for forcing the lubricant material from the lubrication supply chamber to one or more of the grooves.
2. (Original) The self-lubricating expansion mandrel of claim 1, wherein the grooves comprise circumferential grooves.
3. (Original) The self-lubricating expansion mandrel of claim 1, wherein the grooves comprise axial grooves.
4. (Original) The self-lubricating expansion mandrel of claim 1, wherein the grooves comprise a pattern of grooves with both an axial and a circumferential component.
5. (Original) The self-lubricating expansion mandrel of claim 4, wherein the pattern of grooves comprises a textured surface.
6. (Original) The self-lubricating expansion mandrel of claim 1, wherein the solid lubricant retained in one or more of the grooves comprises a self-lubricating film.

7. (Original) The self-lubricating expansion mandrel of claim 6, wherein the depth of the grooves is in a range of between about 1 and 4 microns.

8. (Original) The self-lubricating expansion mandrel of claim I, wherein the solid lubricant retained in one or more of the grooves comprises a fluoropolymer coating.

9. (Original) The self-lubricating expansion mandrel of claim 8, wherein the depth of the grooves is in a range of between about 10 and 50 microns.

10. (Original) The self-lubricating expansion mandrel of claim 1, wherein the solid lubricant retained in one or more of the grooves comprises a thermo-sprayed coating.

11. (Original) The self-lubricating expansion mandrel of claim 10, wherein the depth of the grooves is in a range of between about 50 and 150 microns.

12. (Original) A self-lubricating expansion mandrel for expanding a tubular member, comprising:

- a housing that defines a lubricant supply chamber including a tapered outer surface;

- a quantity of a lubricant material within the lubricant supply chamber;

- a textured pattern formed in the tapered outer surface;

- solid lubricant retained in a plurality of troughs formed in the textured pattern;

and

- means for forcing the lubricant material from the lubrication supply chamber to one or more of the troughs.

13. (Original) The self-lubricating expansion mandrel of claim 12, wherein the solid lubricant retained in the plurality of troughs formed in a textured pattern comprises a self-lubricating film.

14. (Original) The self-lubricating expansion mandrel of claim 13, wherein the depth of the plurality of troughs formed in a textured pattern is in a range of between about 1 and 4 microns.

15. (Original) The self-lubricating expansion mandrel of claim 12, wherein the solid lubricant retained in the plurality of troughs formed in a textured pattern comprises a fluoropolymer coating.

16. (Original) The self-lubricating expansion mandrel of claim 15, wherein the depth of the plurality of troughs formed in a textured pattern is in a range of between about 10 and 50 microns.

17. (Original) The self-lubricating expansion mandrel of claim 12, wherein the solid lubricant retained in the plurality of troughs formed in a textured pattern comprises a thermosprayed coating.

18. (Original) The self-lubricating expansion mandrel of claim 12, wherein the depth of the plurality of troughs formed in a textured pattern is in a range of between about 50 and 150 microns.

19. (Original) A self-lubricating expansion mandrel for expanding a tubular member, comprising:

- a housing including a tapered outer surface;
- one or more grooves formed in the tapered outer surface; and
- a grease supply chamber in the housing;
- a conduit from the grease supply chamber to one or more of the grooves; and
- means for forcing grease from the grease supply chamber through the conduit to one or more of the grooves.

20. (Original) The self-lubricating expansion mandrel of claim 19, wherein the one or more grooves comprise circumferential grooves.

21. (Original) The self-lubricating expansion mandrel of claim 19, wherein the grooves comprise axial grooves.

22. (Original) The self-lubricating expansion mandrel of claim 19, wherein the grooves comprise a pattern of grooves with both an axial and a circumferential component.

23. (Original) The self-lubricating expansion mandrel of claim 22, wherein the pattern of grooves comprises a textured surface.

24. (Original) A self-lubricating expansion mandrel for expanding a tubular member, comprising:

- a housing defining a lubricant supply chamber including a tapered outer surface;
- one or more grooves formed in the tapered outer surface;
- a quantity of a lubricant material within the lubricant supply chamber;
- solid lubricant retained in one or more of the grooves; and
- means for forcing the lubricant material from the lubricant supply chamber to one or more of the grooves;

wherein the grooves comprise circumferential grooves.

25. (Original) A self-lubricating expansion mandrel for expanding a tubular member, comprising:

- a housing defining a lubricant supply chamber including a tapered outer surface;
- one or more grooves formed in the tapered outer surface;
- a quantity of a lubricant material within the lubricant supply chamber;
- solid lubricant retained in one or more of the grooves; and
- means for forcing the lubricant material from the lubricant supply to one or more of the grooves;

wherein the grooves comprise axial grooves.

26. (Original) A self-lubricating expansion mandrel for expanding a tubular member, comprising:

- a housing defining a lubricant supply chamber including a tapered outer surface;
- one or more grooves formed in the tapered outer surface;
- a quantity of a lubrication material within the lubricant supply chamber;
- solid lubricant retained in one or more of the grooves; and
- means for forcing the lubrication material from the lubricant supply chamber to one or more of the grooves;

wherein the grooves comprise a pattern of grooves with both an axial and a circumferential component.

27. (Original) A self-lubricating expansion mandrel for expanding a tubular member, comprising:

- a housing that defines a lubricant supply chamber including a tapered outer surface;
- a quantity of a lubricating material within the lubricant supply chamber;
- a pattern of grooves formed in the tapered outer surface;
- solid lubricant retained in the pattern of grooves; and
- means for forcing the lubricating material from the lubricant supply chamber to one or more of the pattern of grooves;

wherein the pattern of grooves comprises a textured surface.

28. (Original) A self-lubricating expansion mandrel for expanding a tubular member, comprising:

- a housing that defines a lubricant supply chamber including a tapered outer surface;
- a quantity of a lubricating material within the lubricant supply chamber;
- one or more grooves formed in the tapered outer surface;
- solid lubricant retained in one or more of the grooves; and

means for forcing the lubricating material from the lubricant supply chamber to one or more of the grooves;

wherein the depth of the grooves is in a range of between about 1 and 4 microns.

29. (Original) A self-lubricating expansion mandrel for expanding a tubular member, comprising:

a housing that defines a lubricant supply chamber including a tapered outer surface;

a quantity of a lubrication material within the lubricant supply chamber;

one or more grooves formed in the tapered outer surface;

solid lubricant retained in one or more of the grooves; and

means for forcing the lubrication material from the lubricant supply chamber to one or more of the grooves;

wherein the depth of the grooves is in a range of between about 10 and 50 microns.

30. (Original) A self-lubricating expansion mandrel for expanding a tubular member, comprising:

a housing that defines a lubricant supply chamber including a tapered outer surface;

a quantity of a lubrication material within the lubricant supply chamber;

one or more grooves formed in the tapered outer surface;

solid lubricant retained in one or more of the grooves; and

means for forcing the lubrication material from the lubricant supply chamber to one or more of the grooves;

wherein the solid lubricant retained in one or more of the grooves comprises a thermo-sprayed coating.

31. (Original) A self-lubricating expansion mandrel for expanding a tubular member, comprising:

- a housing that defines a lubricant supply chamber including a tapered outer surface;

- a quantity of a lubrication material within the lubricant supply chamber;

- one or more grooves formed in the tapered outer surface;

- solid lubricant retained in one or more of the grooves; and

- means for forcing the lubricating material from the lubricant supply chamber to one or more of the grooves;

- wherein the depth of the grooves is in a range of between about 50 and 150 microns.

32. (Original) A self-lubricating expansion device for expanding a tubular member, comprising:

- a housing including a tapered outer surface;

- one or more depressions formed in the tapered outer surface; and

- a lubricant supply chamber defined in the housing;

- a conduit from the lubricant supply chamber to one or more of the depressions;

- and

- means for forcing lubricant from the lubricant supply chamber through the conduit to one or more of the depressions.

33. (Original) The self-lubricating expansion mandrel of claim 32, wherein the one or more depressions comprise circumferential grooves.

34. (Original) The self-lubricating expansion mandrel of claim 32, wherein the depressions comprise axial grooves.

35. (Original) The self-lubricating expansion mandrel of claim 32, wherein the depressions comprise a pattern of grooves with both an axial and a circumferential component.

36. (Original) The self-lubricating expansion mandrel of claim 35, wherein the pattern of grooves comprises a textured surface.

37. (Original) A self-lubricating expansion device for expanding a tubular member, wherein the interface between the expansion device and the tubular member, during the expansion process, includes a leading edge portion and a trailing edge portion, comprising:

- a housing including a tapered outer surface;
- one or more first depressions formed in the leading edge portion of the tapered outer surface; and
- a lubricant supply chamber in the housing;
- a conduit from the lubricant supply chamber to one or more of the first depressions;
- means for forcing lubricant from the lubricant supply chamber through the conduit to one or more of the depressions;
- one or more second depressions formed in the trailing edge portion of the tapered outer surface; and
- a solid lubricant provided within one or more of the second depressions.

38. (Original) The self-lubricating expansion mandrel of claim 37, wherein one or more of the first and second depressions comprise circumferential grooves.

39. (Original) The self-lubricating expansion mandrel of claim 37, wherein one or more of the first and second depressions comprise axial grooves.

40. (Original) The self-lubricating expansion mandrel of claim 37, wherein one or more of the first and second depressions comprise a pattern of grooves with both an axial and a circumferential component.

41. (Original) The self-lubricating expansion mandrel of claim 40, wherein the pattern of grooves comprises a textured surface.

42. (Previously presented) A method of lubricating the interface between an expansion device and a tubular member during an expansion of the tubular member using the expansion device, wherein the interface between the expansion device and the tubular member comprises a leading edge portion and a trailing edge portion, comprising:

injecting a fluid lubricant into the leading edge portion; and
providing a solid lubricant in the trailing edge portion.

43. (Previously presented) A system for lubricating the interface between an expansion device and a tubular member during an expansion of the tubular member using the expansion device, wherein the interface between the expansion device and the tubular member comprises a leading edge portion and a trailing edge portion, comprising:

means for injecting a fluid lubricant into the leading edge portion; and
means for providing a solid lubricant in the trailing edge portion.

44. (Previously presented) A method of lubricating the interface between an expansion device and a tubular member during an expansion of the tubular member using the expansion device, wherein the interface between the expansion device and the tubular member comprises a leading edge portion and a trailing edge portion, comprising:

providing a supply of a fluid lubricant within the expansion device; and
injecting the fluid lubricant into the leading edge portion.

45. (Previously presented) A system for lubricating the interface between an expansion device and a tubular member during an expansion of the tubular member using the expansion device, wherein the interface between the expansion device and the tubular member comprises a leading edge portion and a trailing edge portion, comprising:

means for providing a supply of a fluid lubricant within the expansion device; and
means for injecting the fluid lubricant into the leading edge portion.

46. – 72. (Canceled).